DOCUMENT RESUME

ED 443 705 SE 063 887

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TITLE	Teaching First Grade Computation: A Comparison of Traditional Instruction and Computer Enhanced Instruction.
PUB DATE	2000-04-27
NOTE	47p.; Master of Arts Research Project, Johnson Bible College.
PUB TYPE	Dissertations/Theses (040)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Computation; Computer Software; *Computer Uses in Education; Grade 1; *Learning Theories; Mathematics Instruction; Piagetian Theory; Primary Education; Teaching Methods
IDENTIFIERS	*Piaget (Jean)

ABSTRACT

A first grade teacher in a rural elementary school in upper East Tennessee observed that her students needed a better way to improve their computation skills than those of traditional instructional methods. The school system's new Mathematics textbook was correlated with commercial Mathematics software. The teacher wanted to find out if using this software to enhance traditional instruction would make a significant difference in the students' computation skills. The psychologist, Jean Piaget saw children as active learners and viewed them as constructors of their own knowledge. He stressed that learning should be meaningful to the learner. According to Piaget, children from ages two to seven are in the preoperational period. In this period, students can manipulate symbols and recognize numerals as symbols for numbers of objects. Teachers should incorporate developmentally appropriate practices that instruct children in a meaningful way. Students should be actively involved in the learning. Developmentally appropriate practices should stimulate intellectual growth by stressing physical manipulation of objects. There are many debates concerning whether manipulation of computer objects is considered physical manipulation and whether it has the same value as manipulation of concrete objects. Sixteen first graders participated as the subjects for this study. These students were divided into a control group and a treatment group. During the nine-week experiment, both groups received traditional instruction covering addition and subtraction facts in a large group setting. In addition, the treatment group used Math Blaster[R] Jr. software for an hour each week to practice computation while the control group received an hour of traditional instruction to equalize the time on task. The control group was given time on the computer so that lack of computer access would not impact the finding. The control group did not use any type of Mathematics software. At the experiment's end, the subjects were given the computation subtest of the CTBS/4 as a post-test. The mean scale score for the control group and for the treatment group were determined. Upon t-test comparison of the mean percentile scores, it was found that there was no significant difference between the scores at the .05 level of significance. However, the control group's mean score was higher than the treatment group's mean score. The teacher had observed that the treatment group subjects became disinterested in the Mathematics software in the latter part of the experiment. The teacher believes that this disinterest led to the lower mean score by the treatment group. (Contains 40 references.) (Author/YDS)

TEACHING FIRST GRADE COMPUTATION: A COMPARISON OF TRADITIONAL INSTRUCTION AND COMPUTER ENHANCED INSTRUCTION

An Action Research Project Presented to the
Department of Teacher Education
Johnson Bible College

In Partial Fulfillment
of the Requirement for the Degree
Masters of Arts in
Educational Technology and Bible

by
Patricia Ann Shults
April 2000

APPROVAL PAGE

This Research Project by Patricia Ann Shults is accepted in its present form by the Department of Teacher Education at Johnson Bible College as satisfying the research project requirements for the Master of Arts in Educational Technology and Bible.

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May 5, 2000

Date

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ACKNOWLEDGMENTS

Grateful acknowledgment is made for the valuable suggestions and help given to me by the members of the Johnson Bible College research project committee.

I would like to express my gratitude to my family for their patience, understanding, and encouragement during the writing of this research project and the duration of this Master's program.

Also, I would like to express my gratitude to my colleagues for their suggestions and encouragement. I would like to extend my deep appreciation to Robin Williamson for her help in compromising with my schedule.

I wish to express my appreciation to my students without whose participation and help this study would have been impossible to complete.

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INTRODUCTION

Significance of the Problem

The state of Math competency in America has been very low for several decades. The United States has lagged behind other countries for at least twenty years. The National Science Foundation joined with the Department of Education in 1979 as a presidential task force and published a report that addressed the nation's position regarding Math and Science. This presidential task force concluded that

> Comparisons between the U. S. and our international competitors suggest that our eminence in basic research is secure. However, our ability to apply technology to our military and industrial pursuits may well be hampered by the relatively low level of scientific and mathematical competence of our non-scientists and, in some respects, by the apparent cooling of science interest among our students generally (Wildavsky, p. 63).

Most industrialized countries stress Mathematics in education for all students. The students in the United States are not required to study Mathematics as in other countries. "A more comprehensive curricular reform is needed in which the average student is exposed to more science, math, and computer use" (Wildavsky, p. 63). To be prepared for the twenty-first century, students need to be mathematically literate. Everyone must learn to value Mathematics and become confident users of Mathematics in their daily lives.

Tennessee is in a predicament similar to the rest of the nation in regards to Mathematics scores. The Mathematics scores of the state's elementary school students fall at or below the nation. According to the 1998 TCAP Achievement scores, Tennessee elementary school students had mean Mathematics composite scores between the 55th and the 65th national percentile (Tennessee Department of Education, 1998). Given the fact that percentiles can range from one to ninety-nine, these national percentiles are misleading because they do not present a clear picture. Over the past six years, Tennessee students have shown a downward trend in composite Mathematics scores, except in eighth grade which has exhibited no change (Tennessee Department of Education, 1998).

It is important to stress Mathematics in our classrooms and to get students interested in the study of Mathematics so that they can become mathematically competent adults. To compete worldwide, the United States cannot enter the next century with a majority of the population who are mathematically illiterate.

Statement of the Problem

The study will investigate whether computer-assisted instruction truly enhances traditional instruction to produce a significant difference in computational scores of first graders. Numerous commercially produced Mathematics softwares provide drill-and-practice. Math Blaster® Jr. software is a product of Davidson & Associates, Inc. It is available in both the IBM compatible and Macintosh platforms on a hybrid CD-ROM. Math Blaster® Jr. has been retitled as Math Blaster® Ages 4-6 by Davidson & Associates, Inc. This study will research whether the Math Blaster® Jr. software will produce a significant difference in first graders' computational scores as opposed to increased traditional Mathematics instruction alone.

Definition of Terms

Traditional Mathematics instruction For the purposes of this study, traditional Mathematics instruction is defined as teacher-directed instruction using the Mathematics textbook, worksheets, hands-on activities, and drill-and-practice activities in large and small groups.

Computer-assisted instruction Computer-assisted instruction (CAI) "often refers to drill-and-practice, tutorial, or simulation activities offered either by themselves or as supplements to traditional, teacher-directed instruction" (Cotton, p. 2). For this study, computer-assisted instruction will be drill-and-practice.

Achievement scores Achievement scores are those obtained from the Mathematics computation subtest of the Comprehensive Tests of Basic Skills, Fourth Edition (CTBS/4) Level 11 Form A.

Limitations

The study will be done in a self-contained class set by enrollment. The class is the only first grade class in the school.

This sample is not a true random sample and does not reflect any population.

Assumptions

The mathematical and learning ability of this sample is assumed to be normally distributed as a result of the process performed to determine the control and treatment groups.

The control and treatment groups are assumed to be of equal ability because the group members were randomly assigned.

Null Hypothesis

Instruction enhanced with Math Blaster® Jr. software as opposed to instruction without this software makes no significant difference in first graders' computation scores to the .05 level of significance.

This hypothesis will be tested using the Mathematics computation subtest of the Comprehensive Tests of Basic Skills, Fourth Edition (CTBS/4) Level 11 Form A.

Chapter 2

REVIEW OF RELATED RESEARCH

The Brain

The brain is a logical processor, which gives people the ability to develop Mathematics skills. Development of the brain is most rapid during prenatal development and during the first year of a child's life. Even though the brain is not fully understood, researchers have learned that one's environment greatly influences brain development. Influences of the environment on this development cannot be reversed. "An adverse environment can compromise a young child's brain functions and overall development, placing him or her at greater risk of developing a variety of cognitive, behavioral, and physical difficulties" (Carnegie Corporation of New York, p. 3). These influences affect the number of brain cells as well as the number of cell connections. The environmental influences also affect the way in which cell connections are arranged and attached to one another. A child's brain development is a factor in his or her school success. Studies of the Carnegie Corporation of New York determined that "although children are resilient and can benefit from later intervention, the costs of reversing the effects of a poor start in life increase as the child grows older, and the chances of success diminish" (Carnegie Corporation of New York, p. 4).

Memory

Children of the same age have differences in memory. A child's ability to remember a situation is influenced by individual characteristics. As humans acquire knowledge, they use that knowledge to establish meaningful relationships with information which helps in remembering the knowledge. Piaget and Inhelder studied memory storage and changes in that storage, which occurs as one develops. Their research led them to conclude that

> The mnemonic code, far from being fixed and unchangeable, is structures and restructured along with general development. Such as restructuring of the code takes place in close dependence on the schemes of intelligence. The clearest indication of this is the observation of different types of memory organization in accordance with the age level of a child so that a longer interval of retention without any new presentation, far from causing a deterioration of memory, may actually improve it (Kahl, p. 92).

As a child attains more knowledge, his or her retention becomes more accurate and the development of mnemonic strategies changes. "As children grow older, they acquire more knowledge about their world, and this acquisition has profound effects on their efforts to remember" (Kahl, p. 100). Change in memory strategies is partially attributed to a child's growing knowledge of mnemonics and memory strategies.

Young children must learn that some situations or learning require memorization. They must also develop the ability to distinguish these memorization situations from situations which do not require memorization. Flavell and Wellman contended that

> Among the important things a growing person may learn is to be attuned to and responsive to those occasions when it is adaptive either to try to retrieve something right now or to prepare himself and/or his environment for effective future retrieval (Kahl, p. 36).

Six-year-olds are capable of determining if information is stored well, but this realization does not mean that they will be lead to study that information more. Some children are capable of using memory strategies in an effective and consistent way, while other children of the same age cannot. In a study conducted by Appel et. al., first graders did understand

> that any memory task calls for some special effort and activity—and thus did possess some concept of 'memorize' versus "just look"—but know less just what to do, in the way of mnemonically effective effort and activity, when confronted with . . . our memory problems (Kahl, p. 38).

Children younger than six do not understand the limitations of memory, relationships concerning memorization, and differing memory tasks. First graders and some kindergartners comprehend their inability to remember all information and that some items are easier to remember than others.

Research by Kennedy and Miller document that children can use memory strategies more effectively if given feedback regarding their strategy. Kennedy and Miller used children of ages six and seven, and divided them into groups of children who spontaneously rehearsed and of children who did not rehearse. The group which did rehearse was trained in verbal rehearsal and then divided in half. When asked to recall information, one-half of the children were given positive feedback about their rehearsal strategy. The other half of the group did not receive any feedback. Kennedy and Miller found that

> Later, when rehearsal was no longer required but was optional, only those children given this feedback continued to rehearse. Strategy training in conjunction with metamemory training was effective, while training strategies alone was not (Kahl, p. 56).

Learning Theories

Various learning theories regard learning in a number of ways. Learning theories are ways in which people try to understand and explain how learning is accomplished.

Three of the most known theories are the constructivist theory, Piagetian or active theory, and the theory of multiple intelligences. All three theories describe the learner as an active learner. This active learner is responsible for constructing his or her own knowledge by exploratory experiences.

According to the constructivist view, learning is a personal experience in which learners develop knowledge and understanding by forming and reforming concepts. The learner's knowledge should be personally meaningful. The learning environment should provide intrinsic feedback to the learner and should allow the learner to express ideas and opinions. Learners should take responsibility for their learning and be able to experiment with their ideas. The learning environment should provide experiences, which relate to the real world.

Constructivism reflects the philosophy of Jean Piaget. Constructivistic theory says that students construct their own learning. Children should be encouraged to handle objects, to observe and predict results, to hear and use language, and to work with other learners to develop ideas. Learners might make temporary mistakes in understanding, but they should be encouraged to learn by doing.

> Constructivistic theory suggests that when students are given interesting and relevant problems, problems they do not have a direct method for solving, they will find alternative methods for solving these problems or create a personal context in which to learn the procedures and skills most applicable to the situation. (Mikusa and Lewellen, p. 160).

The learner is a constructor of knowledge through his or her own activity. Students are doing and thinking instead of listening to others for the answer. The motivation of the learner is very critical to the learning process because the learner's interaction and control of the pace is essential. "The constructivist theory is supported by ongoing definitive research in cognitive psychology and Mathematics education" (Mikusa and Lewellen, p. 163). New technologies can foster the active, collaborative learning that constructivists desire. This technology may aid in constructive processes that we believe to be in the developing children

> With the increasing accessibility of computers to students, we are faced with the prospect of being able to open up avenues for individual discovery learning with the school setting because computers can help us provide for individual learning with the school curriculum (Williams and Williams, p. 21).

Children learn when they are engaged in and in control of their own education and knowledge. Constructive learning is a process of constructing mental models.

Using the computer, children can begin to construct their own learning. "Learning in this environment needs to focus on what children can do with a computer. Computer play can be part of exploratory learning. We all learn by constructing, exploring, and building theories" (Williams and Williams, p. 21). Constructivist education should be adaptive, individualized, and interactive.

Piaget had views similar to the constructivist theory. He saw children as builders of their own knowledge. Piaget stressed that children are active learners. Piagetian theory states that nearly every child is intelligent enough to learn elementary school subjects. Piagetian based instruction requires the learner to reason, infer, and relate things. Piaget theorized that learners constantly reconstruct and reinterpret. Learning is meaningful and organized. Piaget viewed storage as construction and retrieval as reconstruction. The developing child acquires retrieval strategies as well as storage strategies.

> Development here consists largely of an increasing ability and propensity to search memory intelligently, efficiently, flexibly, systematically, exhaustively, selectively, indirectly—in whatever manner the specific retrieval problem at hand requires (Flavell, p. 271).

According to Piaget, children ages two to seven are in the preoperational period. Using the computer during these years, children can manipulate symbols, begin to develop symbolic thinking, and recognize numerals as symbols for numbers of objects (Williams and Williams, p. 22). During the preoperational period, children can learn using the computer for calculations as well.

Existing evidence suggests that cognitive growth is not as stage-like as Piaget's theory claims. For this reason, Neo-Piagetian theorists are attempting to develop a stage model that retains some of Piaget's work and incorporates some modern emphasis. At the same time, they are trying to omit some of the less promising aspects of Piagetian theory such as logical-mathematical structures.

Like Piaget, Howard Gardner's theory incorporates a logical-mathematical component. Gardner's theory of multiple intelligence divides intelligence into eight main intelligences. Gardner's multiple-intelligence theory includes verbal-linguistic, logical-mathematical, musical-rhythmic, visual-spatial, bodily-kinesthetic, interpersonal, naturalist, and intrapersonal intelligences. Gardner believes that intelligences are a product of genetic and environmental factors. Individuals will have blends or combinations of these intelligences. According to Gardner, people with a particular intelligence such as logical-mathematical intelligence have the natural ability to manipulate numbers. Gardner emphasizes that people should acknowledge the cruel truth that it is impossible to gain competence across the span of knowledge domains. Knowledge is accruing at such a quick pace that no one can know all that is known about our world.

Developmentally Appropriate Practices

Developmentally appropriate practices reflect the theory of constructivism. Children should be in control of their learning process and can construct concepts by exploring. Developmentally appropriate activities are open-ended and child-centered.

> The value of developmentally appropriate practices is supported by current research. A qualitative study in 1987 by Hoot, et. al. found that developmentally appropriate practices should be a goal of programs, but several changes are necessary (Hoot, et. al., p. 168).

These changes in the way that children are instructed would be necessary in order to provide the appropriate learning environment for cognitive skills development. These changes include an increase in intrinsic motivation for children, increased child-directed learning activities, and a decrease in drill-and-practice.

Developmentally appropriate practices emphasize "children's individual differences in temperament and the pace of growth, age related abilities and learning styles, and cultural differences" (Bowman, p. 8). Activities should be meaningful experiences for the children. During these activities, children should be actively doing and thinking instead of listening to the teacher's lesson. Developmentally appropriate practices should stress physical manipulation to stimulate intellectual growth of young children.

According to research by Haugland (Haugland and Wright, p. 9-10), the type of computer experiences which children receive determines whether learning is enhanced. Haugland studied developmental and non-developmental softwares' effects on children. Four classrooms of children were used in the study. Three of the classrooms received three one-hour sessions of computer time weekly. One classroom was provided non-developmental software. The second classroom was exposed to developmental software. Developmental software reinforced with supplemental activities was given to the third classroom. The fourth classroom did not have computer access. Haugland found that children with computer exposure had significant gains in self-esteem. Children who used developmental software also showed significant gains in intelligence, non-verbal skills, structural knowledge, long-term memory, and complex manual dexterity. The third classroom which used supplemental activities in addition to the software also showed gains in verbal skills, problem solving, abstraction, and conceptual skills. Haugland found that the classroom using non-developmental software had significant losses in creative abilities. "Clearly, nondevelopmental software had a detrimental effect on children's creative abilities. This should be of concern to anyone using drill and practice software with young children" (Haugland, p. 9).

There is much debate concerning whether manipulation of objects on the computer screen is considered physical manipulation. Much of the debate centers on the definition of the term "concrete."

> Certainly the tradition and theory of developmentally appropriate practice emphasizes actual experiences with objects that can be held and moved physically by children. This is also clearly what Piaget intended, though it is possible, maybe even likely, that he would modify his views if he was able to investigate computer based experience" (Harbeck, p. 41).

Piaget stated that the instruction should match the capability of the child. Children of seven-years-old do have some ability to think abstractly.

Mathematics

Mathematics is an integral part of the learning experience. Students should be able to add, subtract, multiply, and divide. They should also be competent in mental computation as well as paper-and-pencil computation. "We also want our students to master the basics of a new information age—problem solving, communicating mathematical concepts, and applying mathematics in real-world settings as part of this challenging mathematics" (Riley, p. 5). The teaching of Mathematics swings like a pendulum from traditional instruction to a more developmentally appropriate instruction.

Mathematics taught in a traditional manner is preoccupied with computation skills and rote learning. Curricular domination of computation skills does not allow sufficient instructional time for other important Mathematics skills. This teaching strategy does not encourage the students to think, reason, and problem solve. The National Council of Teachers of Mathematics standards state that "Children should master the basic facts of arithmetic that are essential components of fluency with paper-and-pencil and mental computation and with estimation" (National Council of Teachers of Mathematics, p. 4).

Young children who experience traditional instruction in the early grades of school learn that Mathematics does not make much sense in the real world. These children become unsure about their ability to understand and learn Mathematics. The way that Mathematics is taught in the traditional classroom often leads to Math anxiety in older students and adults.

Mathematics should be taught with an active and constructivist view of learning in mind. Students can learn paper-and-pencil computation algorithms, but the learning should be in the context of real world problem solving situations. In a study by Perlmutter, et. al. about Mathematics and real-life use, "Only 5% of first graders gave answers related to real life" (Perlmutter, et. al., p. 67). This study included students in Kindergarten through Third Grade. The study concluded that children did not see the purpose of math outside the school realm.

Students' attitudes and motivation play an important role in the learning of Mathematics. A study conducted by Brophy in 1987 found that

> Motivation plays an important role in mathematics learning. The effort that a student puts forth in math learning is equal to the competence felt about the learning times the value placed on the learning by the student (Perlmutter, et. al., p. 59).

Students require exploratory Mathematics experiences so that they can discover the relationships among numbers. Drill and practice should be practiced with a cluster of facts after children have developed some efficient way to derive the answers to those facts.

Computer-Assisted Instruction

Computer-Assisted instruction includes the use of the computer for tutorials, drill-and-practice, games, or simulation. The effects of Computer-Assisted instruction on young children are not fully known because current research is contradictory. Research by Haugland (Haugland and Wright, p. 9-10) found that children who used developmentally appropriate computer activities showed increases in their self-esteem, intelligence, memory, and dexterity. In 1996, the National Association for the Education of Young Children (NAEYC) adopted a position statement entitled Technology and Young Children—Ages 3 to 8. The National Association for the Education of Young Children's position stressed that the educator must strive to find developmentally appropriate learning tools (NAEYC, p. 1). In their statement, the NAEYC stated that research by Clements found that

> computers supplement and do not replace highly valued early childhood activities and materials, such as art, blocks, sand, water, books, exploration with writing materials, and dramatic play. (NAEYC, p. 1)

There are those who are opposed to young children's use of computers due to perceived dangers to the child.

> They fear computers will replace other activities, will rob children of their childhood, are too abstract, provide children an unrealistic image of the world, lead to social isolation, reduce feeling awareness and creativity. (Haugland and Wright, p. 6)

Haugland's study (Haugland and Wright, p. 9-10) revealed that children using non-developmentally appropriate software such as drill and practice programs had significant losses in creative abilities. Though drill and practice is not deemed a developmentally appropriate practice, computers are being used this way in the classroom. "Driven by the wish to raise low scores on standardized tests, schools and centers frequently endorse drill-and-practice type activities"(Bowman, p.13). Nickerson and Zodhiates see the computer as way to boost skills.

> There are two ways to make human intelligence more powerful through interaction with a computer. One is to use the computer as a temporary device to boost human knowledge or skill, with the goal of bringing students to a point where they can perform complex tasks competently without the computer (Nickerson and Zodhiates, p. 163).

In 1985, a study by Spivey to evaluate the effects of a computer game on mathematics scores showed no significant difference between the control and experimental groups (Spivey, p. 25). However, Spivey did not equalize the instructional time of the groups. The control group did not receive the same amount of Mathematics instruction as the treatment group. The computer game provided more time-on-task for the treatment group.

Larry Edgell conducted a study to determine if computer-assisted instruction makes a significant difference in test scores. Two classrooms of West Virginia fifth graders were used for the study. Edgell compared the academic gains of students who received computer-assisted instruction with the academic gains of students who received an equal amount of traditional instruction. Edgell's study concluded that there is no significant difference between the scores of computer-assisted instruction and the scores of students who received only traditional instruction.

Other research found that computer-assisted instruction supplemented traditional instruction produced higher achievement than traditional instruction alone (Cotton, p. 3). Computer-assisted instruction also seems to speed the learning process. A study by Capper and Copple found that students learned material faster using computer-assisted instruction or that students learned more material in the same timeframe (Cotton, p. 4).

Computers seem to have more benefit for certain students. "Research confirms it is not computers, but the type of computer experiences provided young children that determine whether computers enhance or inhibit development" (Haugland and Wright, pp. 8-9). In computer-assisted instruction, the learners have the luxury of answering in privacy. Some students may tend to feel more comfortable in this setting and perform better. High achievers tend to go faster when using computer-assisted instruction. Computer-assisted instruction becomes "a kind of discovery learning as they figure out for themselves how to solve unfamiliar problems" (Becker and Hativa, p. 100). Studies seem to indicate that younger students tend to benefit more from computer-assisted instruction than older students (Cotton, p. 6). "While CAI does have some capability to individualize the sequence of instruction, and has been shown to improve effectiveness in the area of basic skills, no software at present can really 'understand' why a given student is having problems" (Wildavsky, p. 109).

Low achievers seem to have trouble with computer-assisted instruction. These learners make frequent keyboard mistakes and have trouble with the format. Due to the computer difficulty, "computer-assisted instruction systems often underestimate the arithmetic skills of low-achieving students and retain them at a level below their performance on paper-and-pencil problems" (Becker and Hativa, p. 100).

The way that computers are utilized in the classroom also influences their benefits. "Computers should be used as a delivery system to improve school effectiveness (with regard to both basic and higher-order skills) in a manner consistent with research findings" (Wildavsky, p.102). Good quality computer-assisted instructional software should apply the principles of learning theories, which are appropriate to the cognitive development of the learner. "Using computers to deliver instruction and practice in math would thus be an example of an application that produces direct learning gains" (Wildavsky, p. 102).

Wildavsky stated that computer use could save time in the classroom, but they could not replace the teacher. "Therefore, whatever time technology can save a teacher in delivering a particular set of instructional tasks creates the potential for a net increase in the time allocated to instruction" (Wildavsky, p. 103).

Drill and Practice

Drill and practice is seen as ineffective because it does not nurture the ideas of children. Some contend that learning by rote is learning without fully understanding the underlying principles. "Children learn to perform specific skills (counting, adding) without knowing the precise meaning of their activity" (Bowman, p. 6). In attempts to improve the low scores on standardized tests, learning institutions frequently revert to drill and practice activities because faith in new standards and teaching strategies is lessened by poor student performance on these tests.

Drill and practice can be of benefit to rote learning and to the polishing of basic skills. Software with drill and practice can provide repetitive practice on lower level cognitive skills such as counting and number facts. "Frequent practice of correct responses, however, is considered key to acquiring knowledge, and drill and practice sets the stage, if it is not a precondition, for understanding" (Bowman, p. 7).

Comprehensive Tests of Basic Skills, Fourth Edition

No achievement test can accurately measure a child's learning or intelligence. "Piaget regards intelligence as a specific instance of adaptive behavior, of coping with the environment and organizing (and reorganizing) thought and action" (Mussen, p. 37). The Comprehensive Tests of Basic Skills, Fourth Edition (CTBS/4) attempts to assess child's learning. The Comprehensive Tests of Basic Skills, Fourth Edition (CTBS/4) provides norm- and criterion-referenced measures of student achievement. It is a basic skills assessment using a multiple-item, multiple-choice, pencil-and-paper format. CTBS/4 is published by CTB/McGraw-Hill. Level 11 of the CTBS/4 tests 1.0 to 2.2 grade levels. The Mathematics computation subtest on Level 11 consists of twenty-eight test items and has a testing time of thirteen minutes. The subtest tests only addition and subtraction.

Conclusion of Related Literature Review

Children are active learners who are constantly constructing and re-constructing their knowledge. Learning experiences should provide meaningful experiences to the learner and allow the learner to experiment. Piaget stressed that the learner should be free to explore and to develop ideas. The learner should also be allowed to make mistakes and to learn from those mistakes. The computer can be utilized to provide this type of learning activities for children.

The type of experiences received from computer use determines whether learning is enhanced or inhibited. The computer should not be used for rote learning activities such as drill and practice. Research by Haugland (Haugland and Wright, p. 9) showed that non-developmental software caused severe losses in students' creativity.

The computer experiences are the key to the affect on students' learning. To produce an enriching learning environment, developmentally appropriate activities must be provided. Developmentally appropriate practices increase the learner's motivation, which is essential to the learning process. Computer activities need to focus on open-ended activities, which allow for learner exploration and manipulation. These activities should be child-centered and learner controlled. The learner needs to be free to use the computer as a tool to extend learning through discovery, exploration, and experimentation.

Chapter 3

METHODS AND PROCEDURES

Subjects

The subjects in the study are first grade students of six or seven years of age. The subjects are in a self-contained classroom in upper East Tennessee. The school population is composed primarily rural students. Approximately ninety-eight percent of the school's population is Caucasian while two percent is Hispanic.

Selection of Subjects

The subjects from a first grade in upper East Tennessee were divided into two groups for the study. The names of the subjects were placed in a container. An assistant drew the names from the container to determine group assignment. The names selected on odd numbered draws were assigned to the control group. Names selected on even numbered draws were assigned to the treatment group.

Testing Procedures

The subjects were given the Mathematics computation subtest of the Comprehensive Tests of Basic Skills, Fourth Edition (CTBS/4) Level 11 Form A at the conclusion of the nine-week experiment. Testing booklets were hand scored by the researcher. This Mathematics computation subtest was used because only addition and subtraction will be taught during the nine-week experiment. This school system does not presently test first graders with any standardized assessment.

Experimental Method

The study was comprised of two groups: the control group that would not use the Math Blaster® Jr. software and the treatment group, which would use the software. The subjects did not know their status in the experiment. The researcher did have knowledge of the subjects' status because the researcher was required to assign tasks to the subjects during the experiment. The control and treatment groups had eight subjects each. The subjects were given the Mathematics computation subtest of the Comprehensive Tests of Basic Skills, Fourth edition (CTBS/4) Level 11 Form A after nine weeks for the experiment. The Mathematics scores of the treatment group were compared to the Mathematics scores of the control group to determine any significant difference.

Math Blaster Jr.® by Davidson and Associates, Inc. was used for several reasons. The software is inexpensive and relatively easy to obtain. Math Blaster® Jr. software is available for both Macintosh and IBM compatible computers with CD-ROM drives. Math Blaster® Jr. is correlated with the Silver-Burdett Ginn textbook, which will be used during whole group instruction.

Time on Task

The experiment ran the course of nine weeks. It began on September 13, 1999 and ended on November 12, 1999. The testing was conducted on the last day of the experiment.

All subjects received one hour daily of traditional Mathematics instruction, which was conducted by the researcher. This was large group instruction using the

Silver-Burdett Ginn Mathematics textbook entitled Mathematics: The Path to Math Success! and the accompanying teacher resource materials, except the Silver-Burdett Ginn MathProcessor™ software. During this experiment, the large group will cover the concepts of addition to ten and subtraction from ten. In addition to the large group instruction, the treatment group received four fifteen-minute computer sessions using Math Blaster® Jr. each week. Total computer time for the treatment group was one hour per week. In addition to the large group instruction, the control group received four fifteen-minute traditional Mathematics instruction each week. The control group received an additional one hour per week of traditional Mathematics instruction. This control group instruction served to equalize the Mathematics instruction between the groups. The control group students received equal computer time so that attitudes concerning computer time did not influence the outcome. However, these control group students did not use any type of Mathematics software until termination of the experiment.

Statistical Analysis

The mean scale score of the control group on the post-test and the mean scale score of the treatment group on the post-test was found. The groups' mean scores were compared using t-test to determine if there was a .05 level of significance.

Chapter 4

RESULTS

Computation

The nine-week experiment involved sixteen first graders who were divided into control and treatment groups. During this experiment, all students received one hour daily of large group instruction which covered addition to ten and subtraction from ten. The treatment group used Math Blaster® Jr. software for one hour per week. The control group participated in one additional hour of traditional instruction to equalize the time on task. The control group was given computer time so that attitudes toward computer use did not have any impact on the finding.

At the end of the experiment, the control and treatment groups were given the computation subtest of the Comprehensive Tests of Basic Skills (CTBS/4) Level 11 Form A. This computation subtest contained twenty-eight items covering addition and subtraction. Using subjects' scale scores, a mean scale score was determined. Comparison of the post-test means of the control and treatment groups were determined not to be significantly different. The control group's mean score was 423.00, while the mean score was 374.50 for the treatment group. The hypothesis stated that students using the Math Blaster® Jr. software would have no significant difference in computation skills from students who received only traditional instruction to the .05 level of significance. The hypothesis was retained at the .05 level of significance.

TABLE 1

Comparison of Post-test Means of Control and Treatment Groups

Groups	N	Mean	Mean Difference	Std. Error of Means	t-ratio	Sig. 2-tailed
Control	8	423.00				
			48.50	27.10	1.789	.095*
Treatment	8	374.50				

* Not Significant

Chapter 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Sixteen first graders from a self-contained classroom were selected to participate in the nine-week research project. All subjects received one hour per day of traditional classroom instruction in a large group setting. Concepts covered during the large group instruction were addition to ten and subtraction from ten. Eight of the students were chosen to use the Mathematics software, Math Blaster® Jr., for one hour per week. This software was chosen because it is correlated to the classroom's new Mathematics textbook. The remaining eight students received one hour per week of traditional classroom instruction to equalize Mathematics instruction time between the groups. Students in the control group were allowed computer access to insure that computer use would not have an influence on the outcome. The control students did not use any kind of Mathematics software.

Conclusions

There was not a significant difference between the scores of the treatment and control groups. One would expect the mean score of the treatment group to be higher than the control group, but it is not the case in this instance. The mean score of the control group exceeded the treatment group. Both groups received the same length of Mathematics instruction. During the research project, the researcher observed that the treatment group subjects became disinterested in the Math Blaster® Jr. software. The researcher believes that this software is inappropriate for first graders. First graders are typically turning seven years old during the school year. Math Blaster® Jr. software targets children who are between the ages of four to six.

Since the control group's mean score was higher than the treatment group, it is concluded that traditional instruction produces a more desirable outcome than the Math Blaster® Jr. software.

Recommendations

The researcher recommends that this software not be used in the first grade classroom. The skills presented by the Math Blaster® Jr. software seem appropriate for first grader students. However, the software presents the skills in a way that is too immature for these students. The students were eager to use the software, which was new to the classroom, but they seemed to lose interest during the last half of the nine-week research project. This observation was also seen in other students who used the software after project completion.

The researcher believes that Math Blaster® Ages 6-9 would be more appropriate for first grade students. For this reason, the researcher recommends doing a two-part research project. This new project would repeat this project and do a similar project with the higher level of Math Blaster®. This two-part research project may be performed by the researcher during the next school year to determine if either software would produce significantly different results.

The researcher also recommends that future research projects should have of larger number of subjects for the experiment.

BIBLIOGRAPHY

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BOOKS

CTB/McGraw-Hill1998/99 Catalog, CTB/McGraw-Hill, 1999.

Fisher, Charles, David C. Dwyer, and Keith Yocam, eds. Education and Technology: Reflections on Computing in Classrooms. San Francisco: Jorsey-Bass Publishers, 1996.

Flavell, John H. Patricia H. Miller, and Scott A. Miller. Cognitive Development. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1993.

Forman, George and Peter B. Pufall, eds. Constructivism in the Computer Age. Hillsdale, NJ: Lawrence Erlbaum Associates, 1988.

Haugland, Susan W. and June L. Wright. Young Children and Technology: A World of Discovery. Boston: Allyn and Bacon, 1997.

Kahl, Robert. The Development of Memory in Children. San Francisco: W. H. Freeman and Company, 1979.

Maddox, Taddy, ed. Tests: A Comprehensive Reference for Assessments in Psychology Education, and Business. 4th ed. Austin, TX: Pro-ed, 1997.

Mussen, Paul. The Psychological Development of the Child. 2nd ed. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1973.

Nickerson, Raymond S. and Philip P. Zodhiates, eds. Technology in Education: Looking Toward 2020. Hillsdale, NJ: Lawrence Erlbaum Associates, 1988.

Poole, Bernard J. Education for an Information Age: Teaching in the Computerized Classroom. Dubuque, IA: Wm. C. Brown Communications, Inc., 1995.

Steinberg, Esther R. Teaching Computers to Teach. Hillsdale, NJ: Lawrence Erlbaum Associates, 1984.

Wildavsky, Aaron, ed. Education in the Computer Age: Issues of Policy, Practice, and Reform. Beverly Hills, CA: Sage Publications, 1983.

Williams, Frederick and Victoria Williams. Microcomputers in Elementary Education. Belmont, CA: Wadsworth Publishing Company, 1984.

PERIODICALS

Cornell, Charles. "I Hate Math! I Couldn't Learn It, and I Can't Teach It!". Childhood Education: Infancy through Early Adolescence, 75:225-230, Summer 1999.

Freeland, Jennifer T. and George H. Noell. "Maintaining Accurate Math Responses in Elementary School Students: The Effects for Delayed Intermittent Reinforcement and Programming Common Stimuli". Journal of Applied Behavior Analysis, 32:211-215, Summer 1999.

Harbeck, Julia D. and Thomas M. Sherman. "Seven Principles for Designing Developmentally Appropriate Web Sites for Young Children". Educational Technology 39:39-44, July/August 1999.

Hoot, James L., Rene s. Parmar, Eeva Hujala-Huttunen, Qiuping Co, and Ana Marie Chacon. "Cross-National Perspectives on Developmentally Appropriate Practices for Early Childhood Programs". Journal of Research in Childhood Education, 10:160-169, 1996.

Lindsey, Gail. "Brain Research and Implications for Early Childhood Education". Childhood Education: Infancy through Early Adolescence, 75:97-100, Winter 1998/1999.

Manouchehri, Azita and Terry Goodman. "Mathematics: Curriculum Reform and Teachers: Understanding the Connections". The Journal of Educational Research 92:27-41. September/October 1998.

McMullen, Mary Benson. "Characteristics of Teachers Who Talk the DAP Talk and Walk the DAP Walk". Journal of Research in Childhood Education 13:216-230, Spring/Summer 1999.

Mikusa, Michael G. and Hester Lewellen. "Now Here is That Authority on Mathematics Reform, Dr. Constructivist". The Mathematics Teacher 92:158-163, February 1999.

Moore, Beverly J. "Situated Cognition versus Traditional Cognitive Theories of Learning". Education 119:161-171, Fall 1998.

Perlmutter, Jane, Lisa Bloom, Terry Rose, and Anita Rogers. "Who Uses Math? Primary Children's Perceptions of the Uses of Mathematics". Journal of Research in Childhood Education, 12:58-70, 1997.

Squires, David. "Educational Software for Constructivist Learning Environments: Subversive Use and Volatile Design". Educational Technology 39:48-54, May/June 1999.

ERIC

Bowman, Barbara T. (February 1998). Math, Science, and Technology in Early Childhood Education. Educational Resources Information Center (ERIC). (ERIC Document Reproduction Service No. ED418774).

Edgell, Larry J. (September 1998). Computer Assisted Instruction versus Classroom Instruction (Mathematics). Educational Resources Information Center (ERIC). (ERIC Document Reproduction Service No. ED425079).

Harvey, Francis A and Christina Wotell Charnitski (February 1998). "Improving Mathematics Instruction Using Technology: A Vygotskian Perspective". Educational Resources Information Center (ERIC). (ERIC Document Reproduction Service No. ED423837).

Riley, Richard W. (January 1998). The State of Mathematics Education: Building a Strong Foundation for the 21st Century. Educational Resources Information Center (ERIC). (ERIC Document Reproduction Service No. ED417939).

Spivey, Patsy M. (March 1985). The Effects of Computer-Assisted Instruction on Student Achievement in Addition and Subtraction at First Grade Level. Educational Resources Information Center (ERIC). (ERIC Document Reproduction Service No. ED263874).

WORLD WIDE WEB RESOURCES

Carnegie Corporation of New York (1994.) Starting Points: Meeting the Needs of Our Youngest Children. Retrieved July 15, 1999, http://www.carnegie.org/starting_points/startpt1.htm.

Cotton, Kathleen. (1997.) Computer-Assisted Instruction. Retrieved June 10, 1999, http://www.nwrel.org/scpd/sirs/5/cu10.html.

Lazear, David G. (1999.) Exploring Multiple Intelligences: New Dimensions of Learning. Retrieved February 27, 2000, http://www.multi-intell.com.

National Association for the Education of Young Children (1998.) Technology and Young Children—Ages 3 through 8. Retrieved July 30, 1999, http://www.naeyc.org/about/position/pstech98.htm.

National Association for the Education of Young Children (1998.) Technology and Young Children—Ages 3 through 8. Retrieved July 30, 1999, http://www.naeyc.org/about/position/pstech98.htm: Citing Clements, D. H., (1994). The Uniqueness of the Computer as a Learning Tool: Insights from Research and Practice, Young Children: Active Learners in a Technological Age, Wright, J. L. and Shade, D. D. (Eds.), 31-50. Washington, DC: NAEYC.

National Council of Teachers of Mathematics (1989.) Curriculum and Evaluation Standards for School Mathematics: Introduction. Retrieved July 30, 1999, wysiwyg://25/http://standards-e.nctm.org/1.0/89ces/2801.htm.

National Council of Teachers of Mathematics (1989.) Curriculum and Evaluation Standards for School Mathematics: K-4 Standard 8: Whole Number Computation. Retrieved July 30, 1999, wysiwyg://22/http://standards-e.nctm.org/1.0/89ces/28044s8.htm.

Richmond, C. Floyd (1994.) Computer-Assisted Instruction Strategies. Retrieved June 30, 1999, http://albie.edu/schmus.mue/515/articles/articles.htm/cai_appr.htm.

Tennessee Department of Education (1996.) TN:Ed: 1996 Report Card. Retrieved July 30, 1999, http://www.k-12.state.tn.us/arc/rptcard96/natlperc.htm.

Tennessee Department of Education (1997.). TN:Ed: 1997 Report Card. Retrieved July 30, 1999, http://www.k-12.state.tn.us/arc/rptcrd97/tcapnp.htm.

Tennessee Department of Education (1998.). TN:Ed: 1998 Report Card. Retrieved July 30, 1999, http://www.k-12.state.tn.us/rptcrd98/tcapresults.htm.

APPENDICES

APPENDIX A

Smoky Mountain Elementary School
135 S. Hwy 32
Cosby, TN 37722
Paul L. Cogburn, Principal
Telephone (423) 487-2255
Fax (423) 487-5382

August 12, 1999

Dear Ms. Shults,

You are granted permission to conduct your proposed research study entitled, "Teaching First Grade Computation: A Comparison of Traditional Instruction and Computer Enhanced Instruction." In all research studies names of individuals, groups, and/or schools may not appear in the text of the study unless specific permission has been granted. A final copy of the completed research document should be submitted to the school's office.

Good luck with your study. Do not hesitate to contact me if you need further assistance or clarification.

Yours truly,

Paul L. Cogburn

Paul L. Cogburn
Principal

APPENDIX B

August 12, 1999

Dear Parents,

I am presently working on a Master's degree at Johnson Bible College. Beginning in September, I will be conducting a research project to determine the effectiveness of certain software on children's learning. At the end of the research, I will be giving the Mathematics part of the Comprehensive Test of Basic Skills (CTBS). I need your permission to use your child in this research project and to give him/her the achievement test. I will send a copy of the achievement test results home once the test is scored. Whether your child participates does not affect his/her grades. If you have any questions, please do not hesitate to call me.

If your child can participate, please sign the attached page and return it. I appreciate your help.

Sincerely,

Ms. Shults

APPENDIX C

Permission to Participate in a Research Study

I give permission for my child, ______________________________ to participate in a research study conducted by Patricia Shults to learn if math software will increase math computation in my child. I understand that my child will not be identified in the research paper in any way. I understand that my child may or may not be using the math software as part of the study, but if the software proves to be beneficial, he or she will have access to it after the study is completed.

______________________________ ______________________

Parent signature Date

SE063087

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Author(s): Patricia Shults

Corporate Source:	Publication Date: April 27, 2000

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